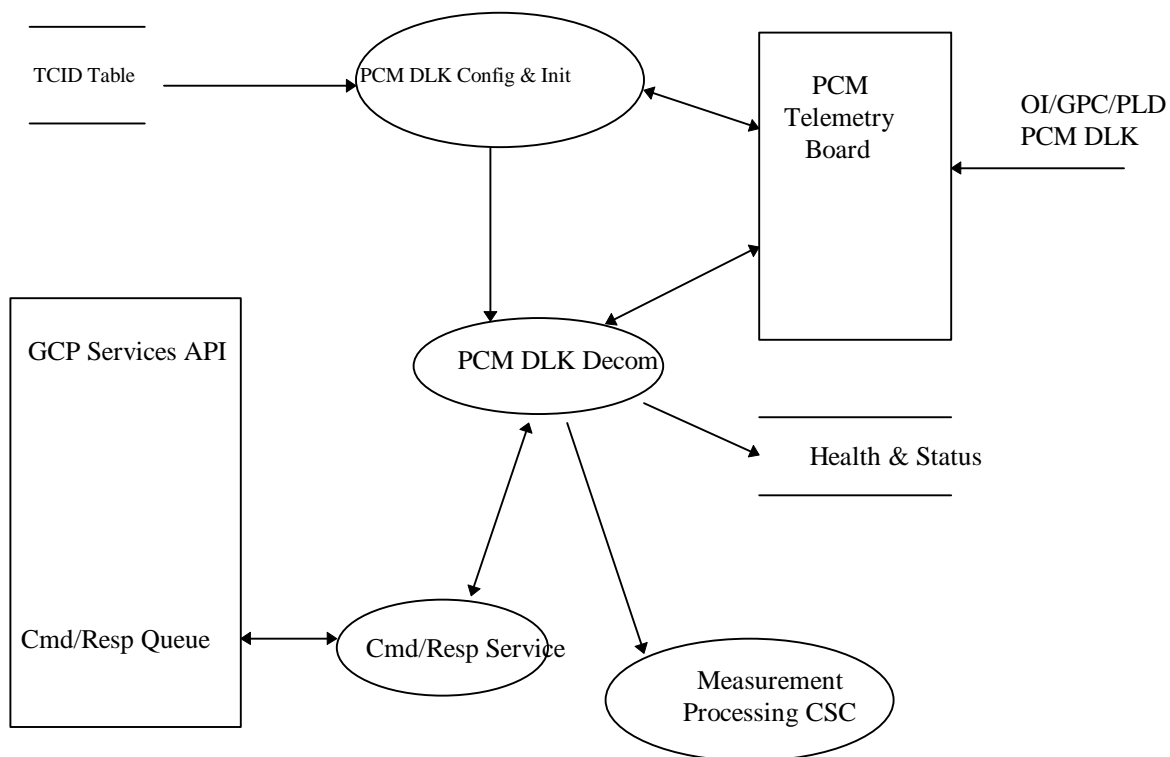# 1. PCM DLK DECOMMUTATION CSC

1.1 PCM DLK DECOMMUTATION CSC Introduction

1.1.1 PCM DLK DECOMMUTATION CSC Overview

The PCM DLK Decommutation CSC is responsible for interfacing with the PCM Downlink HWCI. This CSC initializes the HWCI to accept downlink telemetry from various Launch Processing System(LPS) external interfaces. This CSC extracts measurement data from the input telemetry stream as directed by Format Lists defined in the TCID Tables, and sends the data to the Measurement Processing CSC to be processed. This CSC is responsible for detecting hardware interface errors and for notifying CLCS via the System Message Interface when an error occurs. It also logs the frame data in which an interface error occurs.

1.1.2 PCM DLK DECOMMUTATION CSC Operational Description

The PCM DLK Decommutation CSC provides several function calls for use by other CSC's. These function calls contain all information required to setup and control the PCM Downlink HWCI. This CSC will use these functions to process a request to define processing and telemetry characteristics, as well as to start and stop data acquisition. When data acquisition is activated, this CSC uses information supplied with the request to access all the required tables in the TCID to initialize the PCM Downlink HWCI and to begin Decom Processing.

The PCM Downlink HWCI digitizes and blocks the telemetry stream in internal toggle buffers as specified by the setup parameters sent to the hardware by this CSC.   The PCM DLK Decommutation CSC is notified via interrupt when a frame of data is available to read out of a toggle buffer.

The PCM DLK Decommutation CSC tracks and processes the data frame as specified in the predefined Gateway TCID Tables. The Format List(FL) entries track the data words one for one and provides a pointer to a Measurement Descriptor Table(MDT) which controls the processing characteristics of each measurement. This CSC extracts the value from the frame data and sends it and a pointer to the appropriate MDT to the Measurement Processing CSC to be processed.

In multiformat PCM Downlink Gateways, this CSC is responsible for detecting Format ID(FID) changes in the telemetry stream. It stops processing of the affected data, performs the functions necessary for processing the new format, and verifies that the new FID is valid.

1.2 PCM DLK DECOMMUTATION CSC Specifications

1.2.1 PCM DLK DECOMMUTATION CSC Groundrules

- TCID tables must be loaded to the Gateway local media storage prior to initialization.

- The GCP Service API is implemented under the Gateway Common Service CSCI.

- All PCM links should be attached.

1.2.2 PCM DLK DECOMMUTATION CSC Functional Requirements

1   INITIALIZATION

1.1   The PCM Downlink Gateway shall acquire Pulse Code Modulation (PCM) Downlink data, defined in the Gateway tables, from the Launch Processing System (LPS) external interface.

1.2   The PCM Downlink Gateway shall provide the capability to select different PCM inputs and update Health and Status with the selection (PCM Select C-C).

1.3   The PCM Downlink Gateway shall provide the capability to detect a valid received sync pattern and its initial polarity.

1.4   The PCM Downlink Gateway shall automatically reverse the polarity on the bit synchronizer if 10 consecutive sync errors received while the bit synchronizer is locked onto the data stream.

1.5   The PCM Downlink Gateway shall process PCM Select Commands and allow the parameters to be changed, including but not limited to: loop bandwidth, source, polarity, rate, and voice (PCM Select C-C).

1.6   The PCM Downlink Gateway shall update the new parameters from a PCM Select Command in the Health and Status area (PCM Select C-C).

1.7   The PCM Downlink Gateway shall provide the capability to process "immediate" PCM Select Commands (PCM Select C-C).

1.8   The PCM Downlink Gateway shall provide the capability to process "pending" PCM Select Commands (PCM Select C-C).

1.9   The PCM Downlink Gateway shall provide the capability to process "cancel" PCM Select Commands (PCM Select C-C).

1.10   The PCM Downlink Gateway shall cancel any previous pending PCM Select Command and restore the sync error threshold to 100 sync errors for a "cancel" PCM Select Command (PCM Select C-C).

1.11   The PCM Downlink Gateway shall process requests to change the number of allowable sync-bits in error (PCM Change Sync. Bits in Error C-C).

2　DATA ACQUISITION

2.1　The PCM Downlink Gateway shall process requests to Activate/Inhibit Data Acquisition (PCM, Activate Data Acquisition C-C and Inhibit Data Acquisition C-C).

2.2　The PCM Downlink Gateway shall provide the capability to Block Funnel Log each minor frame of data before processing it.

2.3　The PCM Downlink Gateway shall issue a system message and update the Health and Status area upon detection of a front end interface error.

2.4　The PCM Downlink Gateway shall report any data dropouts to the Measurement Processing CSC.

2.5　The PCM Downlink Gateway shall issue a system message and update the Health and Status area upon detection of data acquisition errors.

2.6　The PCM Downlink Gateway shall execute a Pending Change/Select Command when sync error threshold is reached.

2.7　The PCM Downlink Gateway shall be capable of determining and verifying the format identification and partitioning the telemetry stream into separate areas and measurements as defined by the format specifications.

2.8　The PCM Downlink Gateway shall correlate the internal organization of a PCM master frame with locally resident PCM downlink format lists.

2.9　The PCM Downlink Gateway shall correlate a position within the PCM master frame with a measurement descriptor table entry.

2.10　The PCM Downlink Gateway shall stop processing measurement data, when an incorrect frame count or an unexpected format ID is recognized, in order to begin a search for sync and the beginning of the next valid frame of data.

2.11　The PCM Downlink Gateway shall not begin processing an area if sync has been lost until sync lock has been regained and the value of the frame count equals the reset value defined for that frame counter in the format list.

2.12　The PCM Downlink Gateway shall determine the reset value to be zero for GPC areas.

2.13　The PCM Downlink Gateway shall allow the reset value to be predefined for payload areas (post THOR).

2.14　The PCM Downlink Gateway shall not process an area that contains both a major frame count and subframe count until both frame counts are correct.

2.15　The PCM Downlink Gateway shall discard voice portions of the downlink data stream.

2.16　The PCM Downlink Gateway shall issue a system message whenever the PCM Downlink Gateway's processing capacity is exceeded.

2.17　The PCM Downlink Gateway shall Block Funnel Log raw data when the PCM Downlink Gateway's processing capacity is exceeded.

2.18　The PCM Downlink Gateway shall issue a system message and update the Health and Status area when a format change has occurred without the appropriate format tables available in the PCM Downlink Gateway.

2.19　The PCM Downlink Gateway shall Block Funnel Log the frame containing the format change when it detects a format change has occurred without the appropriate format tables available in the PCM Downlink Gateway.

2.20　The PCM Downlink Gateway shall have the capability to detect a frame with invalid sync.

2.21　The PCM Downlink Gateway shall Block Funnel Log the first three consecutive frames with invalid sync and discard the fourth and following consecutive frames with invalid sync.

2.22　The PCM Downlink Gateway shall issue a system message and update the Health and Status area when it stops/resumes processing.

2.23　The PCM Downlink Gateway shall provide the capability to process up to eight distinct PCM areas.

2.24   The PCM Downlink Gateway shall be capable of tracking sync slippage in an embedded area within the PCM data stream.

2.25   The PCM Downlink Gateway shall lose no more than two major frames of PCM downlink data upon detection of a format change.

2.26   The PCM Downlink Gateway shall issue a system message and update the Health and Status area upon detection of a frame with invalid frame count.

2.27   The PCM Downlink Gateway shall Block Funnel Log only the first frame with invalid frame count and discard following consecutive frames with invalid frame count.

2.28   The PCM Downlink Gateway shall process requests to Activate/Inhibit Serial Dumps (PCM Activate/Inhibit Serial Dump C-C) .

2.29   The PCM Downlink Gateway shall set the subsystem Terminal Error Indicator and send out a system message if the time between PCM HWCI interrupts exceed the Interrupt Timeout Value.

3   Operational Flight Instrumentation (OFI) Data Acquisition

3.1   The OFI PCM Downlink Gateway shall process OI, PLD (post THOR), and GPC downlist data.

3.2   The OFI PCM Downlink Gateway shall process requests to change the decom to area assignment for a given OI format (post THOR).

3.3   The PCM Downlink Gateway shall reject requests to change the decom to area assignment if data acquisition is in progress (post THOR).

3.4   The OFI PCM Downlink Gateway shall be capable of processing one OI data area and up to three distinct GPC areas in a single Master Frame.

3.5   The OFI PCM Downlink Gateway shall be capable of processing one OI data area and up to four distinct PLD areas in a single Master Frame (post THOR).

3.6   If a format change occurred in the OI portion of the data stream, the OFI PCM Downlink Gateway shall Block Funnel Log the OI minor frame with the new format ID.

3.7   The OFI PCM Downlink Gateway shall be capable of handling format changes to any of the embedded areas of measurement data, each independent of the others.

3.8   The OFI PCM Downlink Gateway shall provide the capability to Block Funnel Log GPC Dump Data.

3.9   The OFI PCM Downlink Gateway shall write the maximum number of words to the GPC dump buffers if the word count is illegal.

3.10   The OFI PCM Downlink Gateway shall verify the checksum, when present, in a memory dump and issue a system message and update Health and Status if incorrect.

3.11   The OFI PCM Downlink Gateway shall have the capability to recover from loss of GPC sync lock at the next GPC frame zero.

3.12   The OFI PCM Downlink Gateway shall allow sync slippage of up to two embedded frames worth of fill data before determing it as an error condition.

3.13   The OFI PCM Downlink Gateway shall issue a system message when sync slippage of the PLD (post THOR) and/or GPC areas relative to the OI downlink exceeds the predefined allowable amount.

3.14   The OFI PCM Downlink Gateway shall issue a system message when sync recovery of the PLD (post THOR) and/or GPC areas is accomplished.

3.15   The OFI PCM Downlink Gateway shall continue its search for sync within an area until it is found.

3.16   The OFI PCM Downlink Gateway shall process GPC area frame count/format ID.

3.17   The OFI PCM Downlink Gateway shall process payload area major and subframe count (post THOR).

3.18   The OFI PCM Downlink Gateway shall begin processing an area after processing a GPC data dump and recognizing the expected format ID in frame zero.

3.19   The OFI PCM Downlink Gateway shall set data invalid indicator for the Gateway in the Health and Status area after 3 consecutive sync errors.

3.20   The OFI PCM Downlink Gateway shall set data invalid indicator for the Gateway in the Health and Status area and discard remaining minor frames in an OI major frame if sync error occurs on minor frame zero.

3.21   The OFI PCM Downlink Gateway shall set data invalid indicators in the Health and Status area for the PLD (post THOR) and GPC areas and reset the expected frame count value in each area's Frame Count MDT to its default value on receipt of a sync or frame count error.

3.22   The OFI PCM Downlink Gateway shall not process data in frame with sync or frame count error.

4   **Operational Flight Instrumentation (OFI) Format Switch**

4.1   The OFI PCM Downlink Gateway shall verify that a new Format ID received in the telemetry stream is valid for the current TCID.

4.2   For OI Area format change, the OFI PCM Downlink Gateway shall resize the format list save areas based on the size information in the Format Descriptor Table(FDT).

4.3   For OI Area format change, the OFI PCM Downlink Gateway shall reinitialize the Decom Tables based on the bandwidth information in the FDT.

4.4   For OI Area format change, the OFI PCM Downlink Gateway shall initialize the new GPC areas with the GPC formats used by the old OI format. If these GPC formats do not fit in the new areas, or if no old GPC format exists, use the Default GPC Format.

4.5   For OI Area format change, the OFI PCM Downlink Gateway shall maintain in Health & Status the Decom Number for each logical payload area of the downlink (post THOR).

4.6   For OI Area format change, the OFI PCM Downlink Gateway shall maintain flags in Health & Status to indicate, for each area of the downlink, whether or not the Format ID is valid for the Gateway.

4.7   For any area format change, the OFI PCM Downlink Gateway shall issue a system message and update the Health and Status area if area 0 has not been successfully initialized.

4.8   For any area format change, the OFI PCM Downlink Gateway shall find the new format in the FDT and validate that the format is compatible with the area. Issue a system message and update the Health and Status area if the format cannot be found, or if the format is incompatible with the area.

4.9   For any area format change, the OFI PCM Downlink Gateway shall setup the appropriate format lists and tables for the decom processing of the area.

4.10   For GPC and PLD (post THOR)area format change, the OFI PCM Downlink Gateway shall save the address of the last Sync MDT, and compute the length of the Data Cycle for this format.

4.11   For GPC and PLD (post THOR)area format change, the OFI PCM Downlink Gateway shall setup the Sync Slippage Value in terms of OI minor frames.

4.12   For any area format change, the OFI PCM Downlink Gateway shall report successful or unsuccessful format switchs via a system message and update Health and Status.

5   **Main Engine (ME) Data Acquisition** (post THOR Release)

5.1   The ME PCM Downlink Gateway shall, during the "arm" step of a request from the active LDB Gateway, issue an Inhibit EIU Processing Command to the PCM Downlink Gateways configured to provide a PCM GPC (OFI) interface.

5.2   The ME PCM Downlink Gateway shall, in processing requests for SSME dump, report success or failure to "arm" to the active LDB Gateway.

5.3   The ME PCM Downlink Gateway shall, in processing requests for SSME Dump, provide the option to "disarm" a previously armed SSME Dump Command by issuing a Activate EIU Processing Command to the PCM Downlink Gateways configured to provide a PCM GPC (OFI) interface.

5.4 The ME PCM Downlink Gateway shall, in processing requests for SSME Dump, provide the capability to "disarm" it if a "go" step is not received within two seconds.

5.5 The ME PCM Downlink Gateway shall terminate an SSME Dump routing request after 50 frames of data without receiving a frame of dump data.

5.6 The ME PCM Downlink Gateway shall send SSME Dump data to the specified syscon.

5.7 The ME PCM Downlink Gateway shall issue an Activate EIU Processing Command to the OFI PCM Downlink Gateways after the dump frame has been received.

5.8 The ME PCM Downlink Gateway shall only Block Funnel Log the first dump frame for two or more consecutive readout requests to the same memory address.

5.9 The ME PCM Downlink Gateway shall provide the capability to monitor SSME data and determine SSME status.

5.10 The ME PCM Downlink Gateway shall support SSME controller data stream memory dump from one of the SSME controllers.

5.11 The ME PCM Downlink Gateway shall Block Funnel Log the 128-word ME controller memory dump.

5.12 The ME PCM Downlink Gateway shall monitor Vehicle Command Words (98 & 99) to determine if memory dump data is expected on the next valid frame.

5.13 The ME PCM Downlink Gateway shall, when processing Block II memory readouts, convert the start address from longword(15 bit) to conceptual (16 bit) before the data is logged or sent to a console.

5.14 The ME PCM Downlink Gateway shall have the capability to recognize and process an SSME Block II Hello Command.

5.15 The ME PCM Downlink Gateway shall have the capability to recognize a Block II Memory Readout Command (#FFF2 or #FFF1).

5.16 The ME PCM Downlink Gateway shall have the capability to recognize a Block II Failure Data Recorder(FDR) Cross Channel Readout Command (#F602 or #F601).

5.17 The ME PCM Downlink Gateway shall have the capability to recognize a Block II IE Low Readout Command(#F312 or #F311).

5.18 The ME PCM Downlink Gateway shall have the capability to recognize a Block II IE High Readout Command(#F322 or #F321).

5.19 The ME PCM Downlink Gateway shall have the capability to recognize a Block II IE I/O Readout Command(#F332 or #F331).

5.20 The ME PCM Downlink Gateway shall Block Funnel Log the first good frame of data following a frame with errors.

5.21 The ME PCM Downlink Gateway shall have the capability to detect a repeat frame flag in the BITE word and process the ME frame of data only if the previous frame was not processed.

5.22 The ME PCM Downlink Gateway shall perform the following validity checks on the ME data stream: sync pattern, column parity, EIU BITE status, repeat frame error check, word count, Controller ID words, and Controller Time Reference word.

5.23 The ME PCM Downlink Gateway shall be capable of utilizing an EIU Sync Pattern to ensure the validity of all frames from the controller.

5.24 The ME PCM Downlink Gateway shall utilize a column parity word which indicates odd parity for each bit position to ensure the validity of all frames from the controller.

5.25 The ME PCM Downlink Gateway shall provide the capability to enable and disable all validity checks except sync pattern check and column parity on ME PCM Downlink Gateway data.

5.26 The ME PCM Downlink Gateway shall determine that all enabled frame validity checks are successful before a frame is processed as valid.

5.27 The ME PCM Downlink Gateway shall maintain the status of the validity checks (enabled or disabled) in the Health and Status area.

5.28   The ME PCM Downlink Gateway shall maintain the total error count for each of the validity checks in the Health and Status area.

5.29   The ME PCM Downlink Gateway shall Block Funnel Log frame data that has failed validity checking.

5.30   The ME PCM Downlink Gateway shall clear the validity error counts in the Health and Status area on a switch in data sources.

5.31   The ME PCM Downlink Gateway shall identify each PCM/ME frame with an invalid word count as a word count error frame.

5.32   The ME PCM Downlink Gateway shall determine the Repeat Frame error check has failed if validity checks are enabled and the repeat frame indicator is on for more than three consecutive frames.

5.33   The ME PCM Downlink Gateway shall declare the link as invalid in the Health and Status area if validity checks are valid and the Repeat Frame Indicator is on for six or more consecutive frames.

5.34   The ME PCM Downlink Gateway shall issue a system message and update Health and Status when an EIU sync error or column parity error is detected in a dump data frame.

5.35   The ME PCM Downlink Gateway shall not perform validity checks of controller ID words in repeat frames.

5.36   The ME PCM Downlink Gateway shall check the BITE word to ensure the validity of all frames from the controller.

5.37   The ME PCM Downlink Gateway shall determine a frame invalid if controller ID words 2 and 3 are not 1's complements of each other when validity checks are enabled.

5.38   The ME PCM Downlink Gateway shall determine the link to be invalid when an individual validity check fails more than three consecutive times.

5.39   The ME PCM Downlink Gateway shall determine the link to be invalid if there are ten consecutive validity check errors of any type.


6   GMT Correlation (post THOR Release)

6.1   The OFI PCM Downlink Gateway shall process GMT Correlation requests.

6.2   The OFI PCM Downlink Gateway shall suspend telemetry stream processing of the OI area during a GMT Correlation request for no more than 1.3 seconds.

6.3   The OFI PCM Downlink Gateway shall suspend telemetry stream processing of the GPC areas during a GMT Correlation request for no more than 3.3 seconds.

1.2.3 PCM DLK DECOMMUTATION CSC Performance Requirements

•   The OFI PCM Downlink Gateway will be capable of processing 64, 96, 128, and 192 KBPS data rates.

•   The OFI PCM Downlink Gateway will be capable of processing each OI minor frame before the next frame is received.

1.2.4 PCM DLK DECOMMUTATION CSC Interfaces Data Flow Diagrams

External Data Flow Diagram
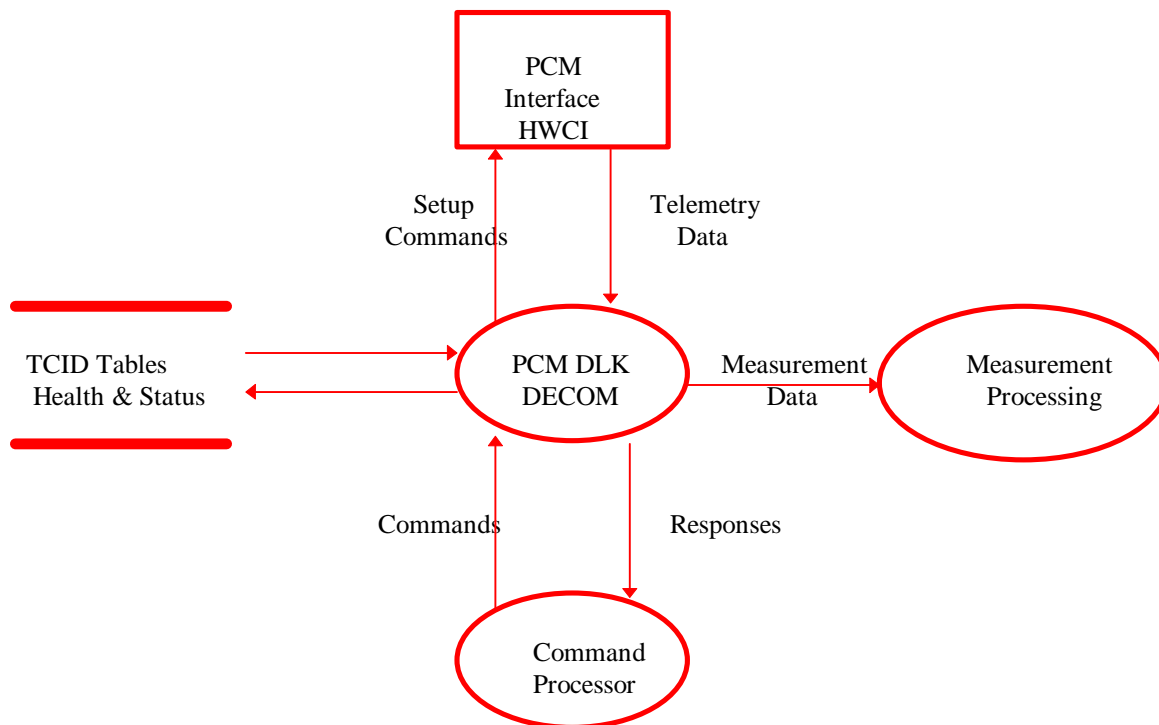
The PCM DLK Decommutation CSC is responsible for all communications with the PCM Downlink HWCI. This CSC processes command requests from the Command Processor to setup processing and telemetry characteristics, as well as to start and stop data acquisition. When data acquisition is activated, this CSC uses information supplied with the Start request to access all the required tables in the TCID to initialize the PCM Downlink HWCI and to begin Decom Processing. These tables are loaded into memory by the PCM DLK Configuration & Initialization CSC.

The PCM DLK Decommutation CSC tracks and processes the telemetry data as specified in the predefined Gateway TCID Tables. The Format List entries track the data words one for one and provides a pointer to an MDT which controls the processing characteristics of each measurement. This CSC extracts the value from the frame data and sends it and a pointer to the appropriate MDT to the Measurement Processing CSC to be processed.

Note: This is the end of the Design Panel 2 Required material.